A Thesis in General Surgery

COLLAGEN DRESSING VERSUS SILVER SULPHADIAZINE DRESSING IN PARTIAL THICKNESS BURNS-A COMPARATIVE STUDY

Submitted in partial fulfillment of the
Requirements for the Degree of
M.S General Surgery
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Kilpauk Medical College
The Tamilnadu Dr. M.G.R Medical University Chennai

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled "**COLLAGEN DRESSING VERSUS SILVER SULPHADIAZINE DRESSING IN PARTIAL THICKNESS BURNS-A COMPARATIVE STUDY"** is a bonafide and genuine research work carried out by me under the guidance of Dr.R.A.Pandyaraj M.S., Professor, Department of General Surgery, Kilpauk Medical College, Chennai.

This dissertation is submitted to THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI in partial fulfillment of the requirements for the degree of M.S. General Surgery examination to be held in April 2014.

Date :

Place : **Dr. K. SATHIK MOHAMED MASOODU**

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation titled "**COLLAGEN DRESSING VERSUS SILVER SULPHADIAZINE DRESSING IN PARTIAL THICKNESS BURNS-A COMPARATIVE STUDY"** is a bonafide research work done by **Dr. K. SATHIK MOHAMED MASOODU,** Post Graduate in M.S. General Surgery, Kilpauk Medical College, Chennai under my direct guidance and supervision in my satisfaction, in partial fulfillment of the requirements for the degree of **M.S. General Surgery.**

Date :

Place :

Dr.R.A.PANDYARAJ M.S.,
Professor,
Department of General Surgery,
Kilpauk medical College,
Chennai

ENDORSEMENT BY THE HOD AND

HEAD OF THE INSTITUTION

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Dr.P.N.Shanmugasundaram M.S.,
Professor and Head,
Department of General Surgery,
Kilpauk Medical College,
Chennai

Date:

Place:

Dr.P.Ramakrishnan M.D. D.L.O.,
Dean,
Kilpauk Medical College,
Chennai

Date:

Place:

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ABSTRACT

Aims : This prospective randomized controlled study was designed to compare the effectiveness of collagen dressing and silver sulphadiazine dressing in partial thickness burns.

Methods : This study was conducted at Government Royapettah Hospital, Chennai. A total of 60 patients with partial thickness burn wounds were included in this study and they are divided into two groups. Group 1 consisted of 30 patients in whom collagen dressing was done. Group 2 consisted of 30 patients in whom silver sulphadiazine dressing was done. The variables analyzed were pain score, infection rate, rate of healing of the wound, resultant scar and patient compliance. Patients with partial thickness burns involving <40% of the total body surface area and wounds not older than 24 hours are inclusion criteria in the study, whereas patients with full thickness burns, burns involving >40% of the total body surface area, wounds older than 24 hours and facial burns are exclusion criteria for this study.

Results : Results obtained were comparable with various authors. When compared to silver sulphadiazine group, patients treated with collagen

dressing had less pain score, reduced wound infection rate, faster healing rate, good scar and good compliance.

Conclusion : Collagen sheet promotes early healing, decreases the need of analgesics, reduces the incidence of associated complications like infection. The morbidity of the patients is reduced as the resultant scar is better in majority of the patients using collagen. Because of the simple application and good tolerance of the membrane, collagen can be advocated as a temporary biological dressing material in partial thickness burns.

Key words : partial thickness burns, dressing, collagen, silver sulphadiazine

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INTRODUCTION

Any scientific research must be properly planned. Such research usually has a rainbow around the corner, which attracts numerous researchers. The chief appeal of a scientific research is the possibility of certain unexpected developments which form a specific pattern out of disorder.

Burn injuries are very painful conditions which usually heal slowly and that too with scarring. They are common entities encountered in our daily clinical practice. Dressings play a vital role in the management of burn wounds.

As burn injuries are common in developing countries, there is an urgent need for a method by which these injuries heal early with less pain, discomfort and scarring.

The major fibrous protein found among the extracellular connective tissues is the collagen. In the whole animal kingdom, collagen is the most plentiful and ubiquitous protein.

The term collagen originated from the greek word 'kola', meaning glue plus gene. Out of the total protein in the human body, 25% is constituted by collagen and it also constitutes about 70% to 80% of skin.

In the past few decades, scientists have developed remarkable interest in employing collagen for collagen.

Hence a need is felt to compare the wound healing process in collagen dressing and dressing with silver sulfadiazine.

AIMS AND OBJECTIVES

To compare the effectiveness of collagen dressing to the silver sulphadiazine dressing in partial thickness burns by means of the following factors

- Pain
- Infection
- Rate of healing
- Patient compliance
- Resultant scar

REVIEW OF LITERATURE

HISTORICAL BACKGROUND:

The oldest written and translated record regarding wounds was discovered by Edward Smith in 1862, which was based on an Egyptian papyrus dated back to 1600 B.C. It describes the use of cotton sutures and the technique of bandaging[1,2].

The Hippocratic collection of 400 B.C describes wound healing by primary and secondary intention. It also explains about 'bad' pus, which was followed by patient's death and 'good' pus, which represents local inflammation and good wound healing[2].

The four cardinal signs of inflammation i.e. rubor, calor, dolor, tumor are described by Celsus (30 B.C – 45 AD)[2]

The use of simple dressing techniques was first demonstrated by Ambrosie Pare in the 16th century AD. He also appreciated the value of hemostasis by practicing the ligation of arteries[2].

The 'salutary' effect of inflammation in the healing process, the phenomenon of wound contraction and factors that delayed or promoted wound healing were first recognized by John Hunter in 1763 AD[2].

When compared with open wounds, wounds that are covered with dressing materials heal faster and with less contracture. By forming a barrier between wound and external environment, dressing materials, they may be either biological or non biological, prevent bacterial infection.

John Lister, who is known as the father of antisepsis, published his works on carbolic acid spray during surgical procedures in 1867[2].

Wounds which are kept moist heal better than those exposed to air was determined by Winter in 1962[2].

Silver sulfadiazine is an effective agent with low toxicity and few side effects in treatment of burn wounds was proved by Hoffmann in 1984.

When compared with non-biological dressing materials, biological dressing materials show better adherence to the wounds. Numerous studies have shown that, dressing materials which adhere well to the wound have certain advantages such as reducing pain, limiting infection and optimizing the rate of healing. To conclude, wound healing is far better in wounds that

are dressed with biologic materials rather than left exposed or covered with non-biologic materials[3].

In 1965, collagen sheet was used to cover wounds for 3 to 4 weeks by Abbenhause and he found that it diminished the fluid loss and it also maintained sterility of the wounds[4].

The mechanism of triggering adhesiveness of platelets and stimulating "release phenomenon", thereby producing aggregation of nearby platelets was demonstrated by Mason and Read in 1974[5].

In 1976, an interesting study was done by Ponten B, Nordgaard. He selected 55 donors and used sterile collagen films as dressing. The aims of his study were to find out whether collagen film could be used as a dressing. He came out with good results in 56% of the cases and fair in 20%. From this study, he inferred that the donor sites were not painful and the need for frequent dressings was eliminated[6].

In 1977, De Vore D. T conducted an experimental study in rabbits. He demonstrated that collagen aided in healing of a surgically created mandibular bone defect and he also noticed that there was immediate cessation and marked reduction in bleeding[7].

In 1978, Gupta R L did an extensive work in the use of collagen sheets as dressing material in the management of burns cases. He found out that, in cases of superficial burns and to a lesser extent in deep burns, collagen sheets were a good biological dressing material. Following application, it prevented wound contamination, loss of serum and electrolytes from the burnt areas[8].

In a study conducted in 1979 by Levin M P,Tsakinos Pi and Cutright D, they used an enzyme – solubilized calf-skin collagen on the wounds that were prepared in the oral cavity of 5 dogs and 15 rabbits. The results of this study indicated that the membrane was biologically acceptable. Also, the applied collagen did not produce any adverse reaction and causes rapid healing[9].

In 1981, S.K Bhatnagar, R. Krishnan and T.C Goel applied collagen sheets over burn wounds as biological dressing. They noticed that on using collagen sheets, repeated dressings were not required. There was good adherence of collagen sheets to the wounds and they stayed in place until epithelialisation was completed it casted off gradually and completely. Besides that, the healing time was much shorter and there was no need for any covering dressing over the collagen sheets. While serving all the

purposes of a skin homograft, the collagen sheet did not have the problem of storage, availability and frequent change of dressing[10].

In 1992, the properties of freeze dried cross-linked bovine type I collagen was studied by P.R. Hyder. He investigated its modulus of elasticity, biodegradation rate and swelling ratio. He found that the physical properties of the collagen were consistent with good handling qualities and appropriate of use at a surgical site[11].

In 1992, the important biological mechanisms involved in wound healing and the main factors that modify the healing process were reviewed by Mian M, Beghe F. He demonstrated the physiological and pharmacological role of collagen. He also discussed the properties of collagen such as its haemostatic effect, its interaction with platelets, its "scaffold" role for fibroblastic proliferation and its role in increasing fluid exudates and the cellular component. He came out with the conclusion that there is clearly a potential for use of collagen in wound repair[12].

In 1995, bovine collagen membranes were used for covering partial thickness burns by Sakiel S, Grzybowski J and he compared it with porcine skin used as biological dressing. He concluded that collagen membrane can

be used as biological dressings and recommended its use for partial thickness burn wound care[13].

In 1995, the usefulness of collagen membrane as a dressing material in covering raw areas which are created after excision of fibrous bands in patients with oral submucous fibrosis was demonstrated by J N Khanna. He conducted this study on 25 patients and concluded that collagen membrane had specific advantages over other methods used in promoting hemostasis, granulation, epithelialisation and preventing the degree of swelling, contracture and morbidity of donor site[14].

The classification of collagen dressings based on their specific use was done by Purna Sai. K in 2000. He also suggested that collagen dressings satisfy all the requirements of an ideal dressing. At the surface of the wound, collagen dressings provide an environment in which healing may take place at an optimum and maximum rate consistent with the production of a healed wound with an acceptable cosmetic appearance[15].

SKIN- ANATOMY:

The skin comprises of two layers:

1.Epidermis

2.Dermis

These two layers rest on the panniculus adiposus, a fatty subcutaneous layer.

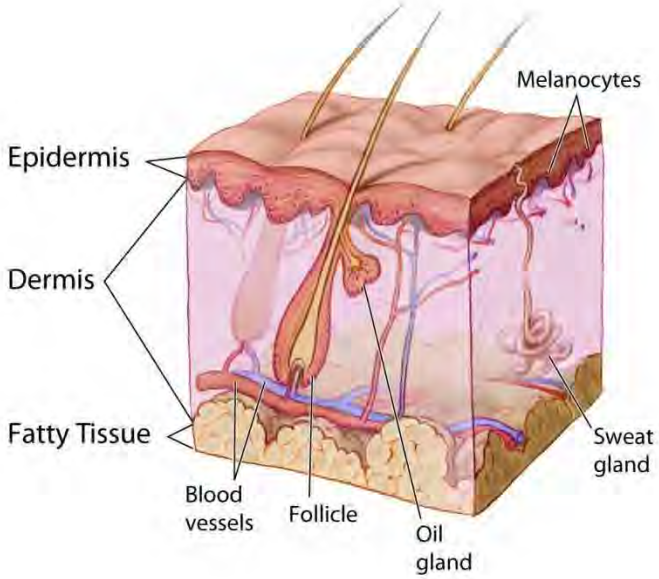


Fig.1: Anatomy of skin

Of these two layers, the superficial epidermis is derived from surface ectoderm. Even though it is ectodermal in origin, this layer is colonized by structures which are derived from other layers such as, Langerhans cells, melanocytes and Merkel cells which are meant for sensing pressure originates from neural crests.

The dermis contains elastic fibers, blood vessels, collagen, sensory structures and fibroblasts and it is derived primarily from mesoderm.

During embryological development, the proliferation and differentiation of ectoderm and the mesoderm beneath it begin at the fourth

week. During this period of development, other structures such as hair follicles, nails of fingers and toes, teeth, apocrine, sweat, sebaceous and mammary glands also start to appear.

Of the above mentioned structures, epidermis forms the nails of fingers and toes, while hair follicles and teeth are formed by both epidermis and dermis. The above said glands are nothing but epidermal glands or epidermal appendages, because of their origin.

Skin is considered to be a dynamic organ. At birth, the skin is multi-layered. Continuous changes occur in the skin throughout our life as the inner layers of the skin replace the outer layers as they shed. There is also variation in the thickness of the skin depending upon various factors such as sex, age of individual and the anatomic location. The variation is primarily due to a difference in the thickness of the dermis. The epidermal thickness does not vary from one region to the other.

The palms and soles have the thickest skin as the thickness in these sites is 1.5 mm. The post auricular region and the eyelids have the thinnest skin as the thickness in these sites is 0.5 mm. Skin of the males is characteristically thicker than that of the females in all anatomic locations.

EPIDERMIS:

The epidermis consists of the following layers namely stratum germinatum, spinosum, granulosum, corneum and lucidum. The epidermis is a stratified squamous epithelium and it lacks blood vessels of its own. It depends upon the dermis beneath for nutrients and to get rid of the waste products which occurs through the junction between the dermis and epidermis by diffusion. The basal layer, stratum germinatum is immediately superficial to the dermoepidermal junction. The epidermis consists of keratinocytes in progressive stages of differentiation.

The keratinocytes, as they undergo division and differentiation, migration occurs towards the superficial layers of epidermis. After reaching the uppermost layer of epidermis, the stratum corneum, the keratinocytes are fully differentiated , devoid of their nuclei and ready for shedding. Among the layers of epidermis, stratum corneum has the largest cells. Depending upon the anatomic location, stratum corneum ranges in thickness from 15 to 100 cells. Stratum corneum acts as protective barrier.

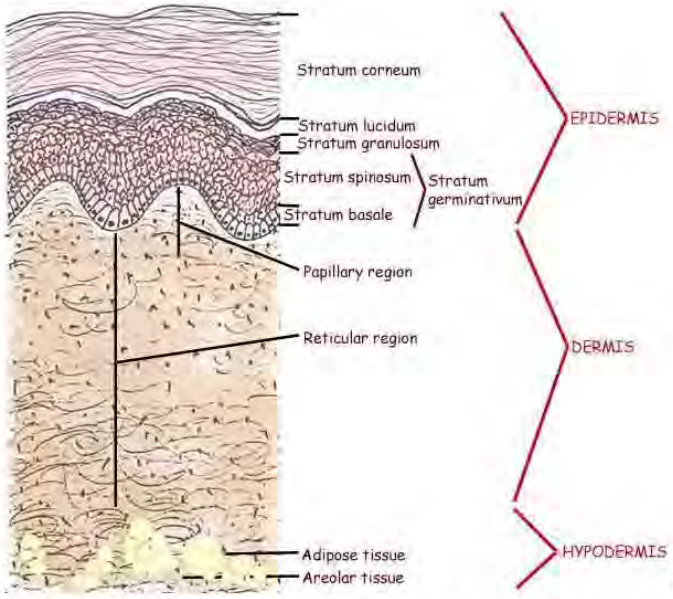


Fig.2 : Layers of is epidermis

The primary function of melanocytes it to produce a pigment named melanin. Melanin has the property of absorbing radiant energy and ultraviolet radiation which are emitted by the sun. Melanosomes are organelles in which the melanin pigment is accumulated and incorporated into dendrites. By the process of phagocytosis, the melanosomes reach the keratinocytes.

Melanocytes present in various sites which include epidermis, uveal tract, retina, hair follicles and leptomeninges. Melanoma originates from these sites.

The ratio of melanocytes to keratinocytes varies depending upon the anatomic location. In sites which are exposed to the solar radiation, the ratio

is 1:4, whereas in areas not exposed to the sun, the ratio may be as low as 1:30.

Difference in complexion among various individuals is primarily due to the size of the melanosomes rather than the amount of melanosomes as the absolute number of melanosomes is found to be same among various races and sexes. The factors which stimulate the production of melanin include melanocyte stimulating hormone (MSH), sun exposure and steroidal hormones.

A gradual reduction is seen in the amount of melanocytes in the epidermis of an individual with aging. The melanocytes have no ability to reproduce as these cells are of neural crest origin.

Langerhans cells are found in all layers of the epidermis except for stratum corneum. These cells function as antigen presenting cells (APC). The langerhans cells, after ingestion of antigens, process them and bind them with major histocompatibility complexes (MHC). These bounded forms are then presented to lymphocytes for the purpose of activation of the immune system.

Contact hypersensitivity is one such example for the above said activation of the immune system.

DERMIS:

The dermis consists of two layers, the superficial and the deep layers. They are named as papillary and reticular dermis respectively. The papillary dermis comprises of loose connective tissue with capillaries, collagen and is thinner than that of reticular dermis. The thicker reticular dermis comprises of dense connective tissue with larger blood vessels, elastic fibers and bundles of collagen fibers. The other structures which are found in the reticular layer of dermis include mast cells, nerve endings, fibroblasts, epidermal appendages and lymphatics.

The major cell type of the dermis is the fibroblast. They produce and secrete two types of fibers namely, procollagen and elastic fibers. The former is converted into collagen followed by which cross-linking occurs. The tensile strength is provided by these tightly cross-linked collagen fibers. 70% of the weight of the dermis is made up by collagen, primarily Type I and Type III collagen. Type I constitutes about 85%, whereas Type III constitutes 15% of the total collagen.

DERMO-EPIDERMAL JUNCTION :

The dermo-epidermal junction is nothing but a basement membrane. It keeps the epidermis adherent to the dermis. The dermo-epidermal junction

comprises of two layers, namely the lamina densa and lamina lucida. The lamina densa is thicker than that of the lamina lucida. The papillary dermis, which is immediately beneath the epidermis has dermal papillae which contain lymphatics. The finger like projections of dermal papillae are surrounded by similar projections from the epidermis, thereby making the dermo-epidermal junction highly irregular and also increases the surface area over which exchange of oxygen, nutrients and waste products occur between the avascular epidermis and dermis.

EPIDERMAL APPENDAGES:

The intradermal epithelial structures which are lined with epithelial cells are called epidermal appendages. These appendages serve as a source of epithelial cells to accomplish re-epithelialisation in situations like abrasions, superficial burns or while harvesting skin graft in which the overlying epidermis is either destroyed or removed. Epidermal appendages comprise of sweat glands, hair follicles, apocrine glands, sebaceous glands and mammary glands

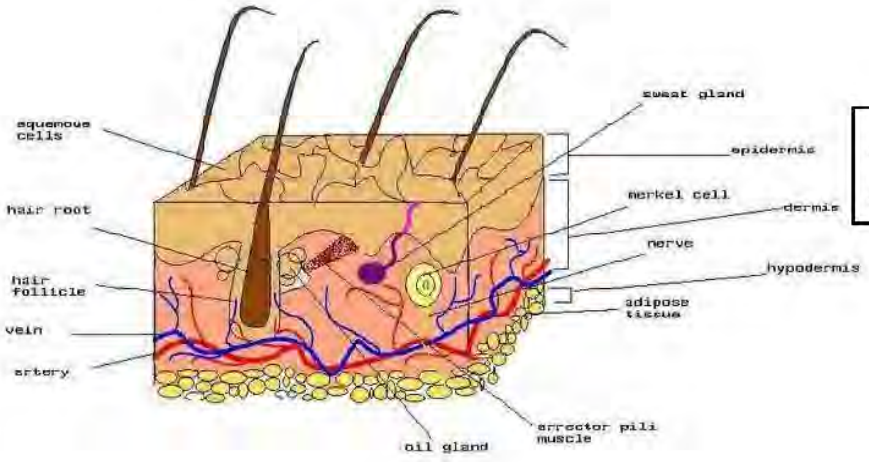


Fig. 3: Epidermal Appendages

SEBACEOUS GLANDS:

Sebaceous glands are present universally all over the body. A group of complex oils including cholesterol, cholesterol esters, wax esters and squalene, named sebum, is produced and secreted by these sebaceous glands. The function of the sebum is to lubricate the skin and to protect it against friction. It also helps in keeping the skin more impervious to moisture.

SWEAT GLANDS:

Sweat or eccrine glands are present over the entire surface of the body except for certain areas which include external ear canal, vermilion border of lips, glans penis, inner aspect of the prepuce, labia minora and the nail beds. Each sweat gland has a secretory portion which is present within the dermis is connected to the exterior through a distal duct. Sweat which is produced

by the sweat glands, cools the body by evaporation. The sweat gland activity is controlled by the thermoregulatory centre in the hypothalamus.

APOCRINE GLANDS:

They resemble eccrine glands in structure and are present in the anogenital region and the axillae and as modified glands at various sites, such as Moll's glands in the eyelids, ceruminous glands in the external ear canal and mammary glands in the breast. The apocrine glands serve a vestigial function until puberty after which they start functioning.

HAIR FOLLICLES:

Hair follicles are distinct structures formed by both layers of the skin. They are present all over the surface of the body except the palms, soles, labia minora, clitoris, glans penis, certain portions of fingers and toes and mucocutaneous junctions.

The secretions of the sebaceous glands most often open into the hair follicles and the entire complex constitutes the pilosebaceous unit.

The hair bulb is the base of the hair follicle and the deep portion of the hair follicle is connected to the superficial dermis by erector pili which are a smooth muscle. Under the control of the sympathetic nervous system,

contraction of the erector pili causes the hair follicle to assume a more vertical orientation[16].

ANATOMY OF HAIR FOLLICLE:

A cyclical pattern is exhibited by hair growth which comprises of three phases, namely, anagen, catagen and telogen. Anagen and the telogen are the growth and resting phases respectively. Catagen phase is the transition between anagen and telogen. Depending on the anatomic location, these phases vary in length. In an anatomic location, hair follicles are present in all the three phases of hair growth at any one time[19].

BLOOD SUPPLY OF THE SKIN:

Blood vessels which supply the skin named cutaneous vessels arise from the named source vessels which lie beneath. Angiosome is termed as a three dimensional vascular territory from bone to skin which is supplied by each source vessel. Angiosomes which lie adjacent to each other have vascular connections through small caliber anastamotic vessels. The cutaneous vessels arise in either of the following two ways, i.e direct branches from source arteries or as terminal branches of muscular vessels. They are termed as septocutaneous or fasciocutaneous and musculocutaneous perforators respectively.

These vessels, on their way to the skin surface, traverse the adjacent connective tissue framework and give branches to the surrounding structures such as bone, nerve, fat, fascia and muscle. After emerging from the deep fascia, they move towards the skin to form plexuses in the sub dermal and dermal layers. Superficial and deep plexuses are horizontally arranged in the dermis and these plexuses are interconnected through communicating vessels. Ultimately, there is extensive anastamosis between the cutaneous vessels of adjacent areas to form an excellent vascular network within the skin. This explains the reason for the survival of random skin flap.

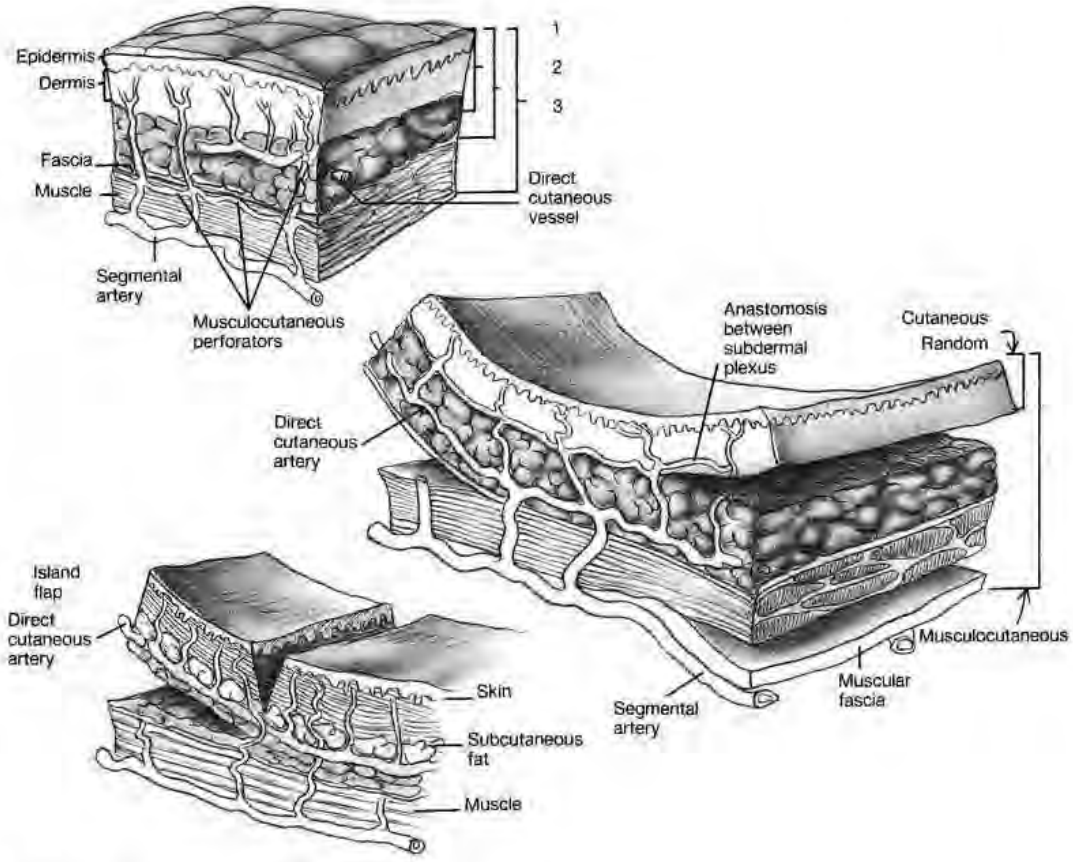


Fig 4: Blood Supply of Skin

Cutaneous vessels play a vital role in the thermoregulation of the human body. Convection from these vessels is an important aspect besides heat loss from sweat evaporation and natural heat conductivity property of the skin. By means of regulation of cutaneous blood flow, large amounts of heat can be exchanged and this flow is ten to twenty times than that of required for the purpose of essential metabolism and oxygenation. The vasoconstriction and vasodilatation of the cutaneous vessels are controlled by the thermoregulatory centre in the hypothalamus through the sympathetic nervous system[20].

LYMPHATICS:

The main functions of the lymphatics are scavenging antigenic substances, foreign material and bacteria and conserving plasma proteins. They arise within the dermal papillae, then reach the plexus beneath the dermis and finally form larger lymphatic channels. These channels finally join the venous circulation after filtering through numerous lymphnodes.

SKIN INNERVATION:

In order to avoid extremes of temperature, pressure, mechanical or traumatic forces, skin has an excellent property of sensory perception. Light

touch is detected by Merkel cells and Meissner corpuscles. Pressure is detected by specialized structures called pacini corpuscles.

Naked nerve endings which are present in the basal layer of epidermis are responsible for pain transmission. Raffini corpuscles and Krause bulbs detect heat and cold respectively. Cutaneous nerves travel along with the blood vessels to the skin. A dermatome is defined as the area supplied by a single segment of the spinal cord or by a single spinal nerve. Overlapping may be seen between adjacent dermatomes which should be kept in mind while performing field blocks with local anesthesia.

MECHANISM OF WOUND HEALING:

Repairing tissues after inflammation and replacing dead or injured cells in the human body is critical to survival. Whenever cells and tissues are damaged by injurious agents, a series of events is initiated by the host to remove these injurious agents, restrict the damage and prepare the remaining surviving cells for replication. Regeneration and healing are the two important processes involved in the repair of damage of tissue caused by wounds, surgical resection and various types of chronic injury. Regeneration leads to restitution of lost tissues whereas healing includes collagen deposition and scar formation besides restoring original structures.

The wound healing is the prototype of tissue repair. It is a changing and dynamic process. Inflammation, granulation tissue formation, tissue remodeling and scarring are the various phases in the process of wound healing. Simple cutaneous incisional wounds usually heal by first intention, whereas large cutaneous wounds heal by second intention. The latter generates a significant amount of scar tissue.

STAGES OF WOUND HEALING:

A. Inflammation:

The initial event is aggregation of platelets around the exposed collagen. The intrinsic clotting cascade is stimulated by the factors secreted by the platelets which interact with and strengthen the platelet aggregate into a stable hemostatic "plug". Variety of growth factors and cytokines are released by the platelets. These include insulin-like growth factor, transforming growth factor-beta, platelet derived growth factor and epidermal growth factor. Variety of inflammatory cells such as neutrophils, eosinophils and monocytes are attracted by these cytokines to the wound site and thereby initiating the inflammatory phase.

The inflammatory cells, mainly neutrophils, macrophages and eosinophils migrate to the wound sites and secrete proteolytic enzymes.

Many peptides are formed during wound healing by the action of these proteolytic enzymes on the macromolecular constituents of the extracellular matrix. These peptides play a main role in recruiting cells such as mononuclear cells, macrophages and neutrophils by the chemotactic effect.

TNF-a secreted by the activated macrophages stimulate the production of IL-1b, which causes up-regulation of matrix metalloproteinase expression and it is mitogenic for fibroblast. Deposition of collagen in the wound is influenced by these pro-inflammatory cytokines, TNF-a and IL-1b.

Migration of epithelial cells, vascular endothelial cells and fibroblasts into the wound is stimulated by these growth factors. This increase in the cellularity of the wound marks the beginning of proliferative phase.

B. Proliferation:

Fibroblast proliferation is stimulated by the products produced by the degradation of collagen. The growth factors secreted by these fibroblasts aid in the formation of the extracellular matrix. Vascular endothelial cell proliferation is also stimulated by these collagen cleavage products.

These vascular endothelial cells in turn produce numerous growth factors, which induce angiogenesis. Granulation is achieved through a vascularised extracellular matrix. The migration and proliferation of

keratinocytes is also stimulated by the collagen cleavage products, followed by which a variety of cytokines and growth factors are secreted by keratinocytes. Re-epithelialisation is achieved once these keratinocytes migrate to the newly formed granulation tissue from the edge of the wound.

C. Remodelling:

For an optimum healing of a wound, a balance is required between the production of new components of the scar matrix and degradation of these components by matrix metalloproteinases. These include collagenase, gelatinase and stromelysin.

Fibroblasts are the major source of matrix metalloproteinases besides synthesizing collagen, proteoglycans and elastin. As the scar matures, there is a decrease in the density of capillaries in the wound and angiogenesis ceases. This results in the creation of a strongest scar.

BURNS:

Ever since man discovered fire, his curiosity has grown enormously to uncover mystery hidden within it. Some went on ascribing divinity to it. Many ancient cultures show the evidence of people worshipping fire. Some are seen to walk over it during certain occasions, on the ember. As the time

passed, man started using it for cooking, disposing waste and for other activities.

Fire was perhaps, man's first double edged sword; for throughout history, it has served as well destroyed mankind. It may boil and bake. At the same time, may God forbid, it burns and 'buries' people. Unfortunately, there is yet no suitable or at least an equal substitute for fire.

Despite knowing the deadliness of fire, man still continues to be callous and 'indifferent' towards handling fire.

The various risk factors include the following,

1. Cooking on open fires
2. Explosion of pressure stoves
3. Instability of small stoves
4. Use of open fires to keep warm during winters
5. Use of inflammable materials in housing and furnishing
6. As means of suicide

Burns are also one of the means of committing violence, especially against women.

Accidentology, which is concerned with research, is expected to offer great insights into such problems related to burns.

The two basic factors which determine the effect of heat on the human body are temperature and time. Anatomy of skin and hypodermis also influence the degree of damage caused by heat. Sweat glands which are present in the dermis and the vascular supply, with blood flowing in the hypodermis serve as remarkable thermo-regulators in the human body.

Whenever a burn occurs, it results in coagulative necrosis of the tissues. The depth of a burn wound depends upon two factors. The temperature to which the skin is exposed and the duration for which the skin is exposed. The depth also depends upon the specific heat of the causative agent.

Causes Of Burns:

1. Flame :

Burns caused by oxidized, superheated air which may cause vesication on the body surface.

2. Hot liquids :

Hot liquids when come in contact with the skin lead to scalds.

3. Contact Burns :

When a highly heated solid body or a molten metal applied to the body for a very short time, it may produce only a blister and reddening corresponding in size and shape to the material used. It will cause destruction or even charring of parts upon contact for some time.

4. Explosions :

Burns caused by explosions in coal mines or of gun powder are usually very extensive and produce blackening and tattooing due to driving of the particles.

5. Iatrogenic :

Burns due to X-rays are usually because of faulty exposure and may vary from mere redness of skin to dermatitis with loss of hair and epidermis and pigmentation.

6. UV rays :

Burns by ultraviolet rays (the sun or mercury vapor lamp) produce erythema / acute eczematous dermatitis

7. Chemicals :

Burns from corrosive substances show ulcerated patches and are usually free from blisters. Corrosion means to destroy something by

chemical action. Strong acids produce dark leathery burns upon the skin. Strong alkalis cause sloughing and leave moist, slimy and grayish areas.

8. Burns by electricity and lightning :

Electric burns may be due to contact with electric circuit or by flash burns, which usually accompanies a short circuit. The latter are essentially same as by flame. Burns by lightning, may appear in the form of arborescent markings on the surface of skin, looking like branches of a tree.

9. Radiant heat burns :

They are caused by heat waves, a type of electromagnetic wave

10. Microwave burns :

They are well demarcated, full thickness burns.

Burns Pathophysiology:

Burns injuries trigger the release of inflammatory mediators in large amounts in both the wound and in other tissues. They in turn produce constriction and dilatation of blood vessels, marked increase in the capillary permeability and edema.

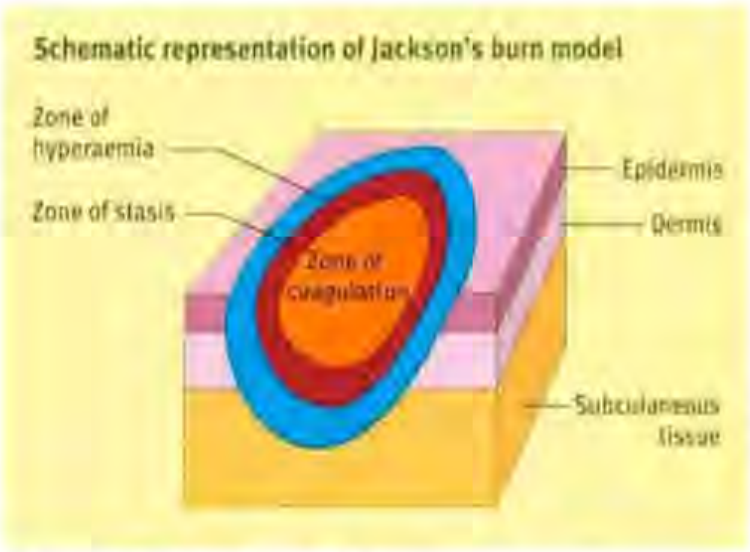


Fig 5: Pathophysiology of Burns

In response to the changes in the starling forces caused by burns, generalized edema occurs in both the burned and unburned skin. There is marked decrease in the interstitial hydrostatic pressure in the burned skin initially. In the non-burned skin, there is an associated mild increase in the interstitial pressure. Due to the protein loss caused by increased capillary permeability, interstitial oncotic pressure increases and plasma oncotic pressure decreases. As a result of these events, generalized edema occurs. As the interstitial pressure is lower, the edema is greater in the burned tissues.

In case of burns, much of the injury is received by the skin. But once the inciting focus is removed, the response developed by the local tissues cause injury to the deeper layers.

There are three zones in the area of cutaneous injury, namely zones of coagulation, stasis and hyperemia.

The zone of coagulation is the necrotic area of a burn wound. The zone of stasis is the area surrounding the zone of coagulation where there is a moderate degree of insult and tissue perfusion is decreased. Depending on the environment of the wound, the zone of stasis may proceed further. It can either survive the insult or progress to coagulative necrosis. Vessel leakage and vascular damage are present in the zone of stasis. In the burn wounds, thromboxane A2, which produces vasoconstriction, is present in large quantity. Inhibitors of these substances may be applied locally to improve blood flow.

The third zone is the zone of hyperemia, which surrounds the burn wound and is characterized by vasodilatation as a result of inflammation. This is the zone from which the healing process begins. This zone consists of clearly viable tissue and they are not at risk for further necrosis.

Burn Depth:

The degree of tissue damage determines the depth of a burn. Burn depth is categorized to the following degrees based on the extent of injury in the epidermis, dermis, subcutaneous fat and surrounding structures.

There are various classifications for burns which are given below,

Table 1: Classification of Burns

Degree of damage	**Dupuytren's**	**Hebra's**	**Wilson's**
Erthema / Redness Vesication	1st degree 2nd degree	1st degree 1st degree	Epidermal
Damage to superficial skin	3rd degree	2nd degree	Dermo-epidermal
Damage to whole skin	4th degree	2nd degree	Dermo-epidermal
Damage to muscles	5th degree	3rd degree	Deep
Damage to deeper tissues including bone etc	6th degree	3rd degree	Deep

When the injuries are confined to the epidermis, they are called first degree burns. They appear erythematous, blanch to the touch, painful and have an undisrupted epidermal barrier. An example for first degree burns is sunburn.

First degree burns heal without any scars and the treatment options include topical soothing applications and oral NSAIDs.

The second degree burns differ from that of the first degree burns by the presence of some degree of damage to the dermis. Second degree burns may be superficial or deep depending upon the depth of injury to the dermis. Superficial burns are erythematous and often blister. Superficial dermal burns are usually painful because of exposed nerve endings. One such example is scald injury from boiling water.

Superficial dermal burns with the help of retained epidermal appendages such as hair follicles and sweat glands, spontaneously re-epithelialize in 7 to 14 days. Following the healing process, such burns leave behind some slight skin discoloration.

The burns which extend into the reticular dermis are termed deep dermal burns. Such burns do not blanch to touch, have a pale and mottled appearance but the patient can experience pain at these sites. Deep dermal

burns, by the process of re-epithelialisation from structures such as, hair follicles and sweat gland keratinocytes heal in about 14 to 35 days. Due to the loss of dermis, the deep dermal burns heal with severe scarring.

Burns involving both the epidermis and the dermis are called third degree burns. Painless hard, leathery eschar which may be black, white or cherry red is the characteristic appearance of third degree burns. They must heal by re-epithelialisation as the epidermal and dermal appendages are destroyed. The full thickness and deep dermal burns must be treated with excision and skin grafting for timely healing of such wounds.

Burns involving the structures underneath the skin, such as muscle, bone are called fourth degree burns.

Assessment of burn depth comes with experience. It is essential to determine the accurate burn depth because the treatment differs with the degree of burns as the full thickness burns require operative intervention whereas the first degree burns heal with local treatment.

The recent advancement in this field is the multi-sensor laser Doppler flowmeter. This device helps in determining the burn depth. Various studies suggest that this flowmeter is superior to the clinical assessment in

determining the burn depth and assessing the requirement of skin grafting. This latest gadget may revolutionize the standard of care in the future[21].

Burn Size:

The Wallace rule of nine is the method generally used to assess the burn size. In adults, the head and neck and each upper limb are assumed as 9% of the total body surface area. Each lower limb and the anterior and posterior aspects of the trunk are assumed as 18% each. The genitalia and the perineum are considered to be 1% of the total body surface area.

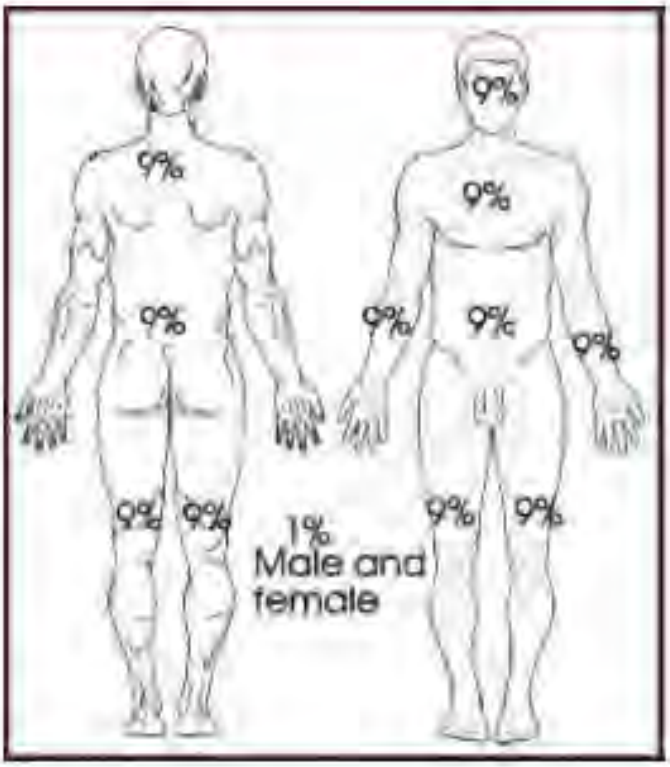


Fig 6: Wallace Rule of Nine

Table 2: Wallace Rule of Nine

Part of the body	**Percentage of the whole body surface**
Head and neck	9
Front of chest	9
Back of chest	9
Front of abdomen	9
Back of abdomen	9
Right upper limb	9
Left upper limb	9
Front of right lower limb	9
Back of right lower limb	9
Front of left lower limb	9
Back of left lower limb	9
Pudendal area	1
Total	100

Another method which is used to estimate smaller burns is to assume the area of the open hand of the patient to be more or less equal to 1% of the

total body surface area. The measurement by this method should be transposed visually onto the wound for the purpose of determination of burn size. This method is quite useful in assessing splash burns and other burns of mixed distribution.

The estimation of burn size in children and infants is different from that of the adults. The surface area is smaller in their lower extremities when compared with their head and neck regions. Infants have as much as 21% of the total body surface area in the head and neck regions and 13% in each of the lower limb. These values approach the adult proportions as age advances. Hence in children and infants, burn size is estimated by using Lund and Browder chart.

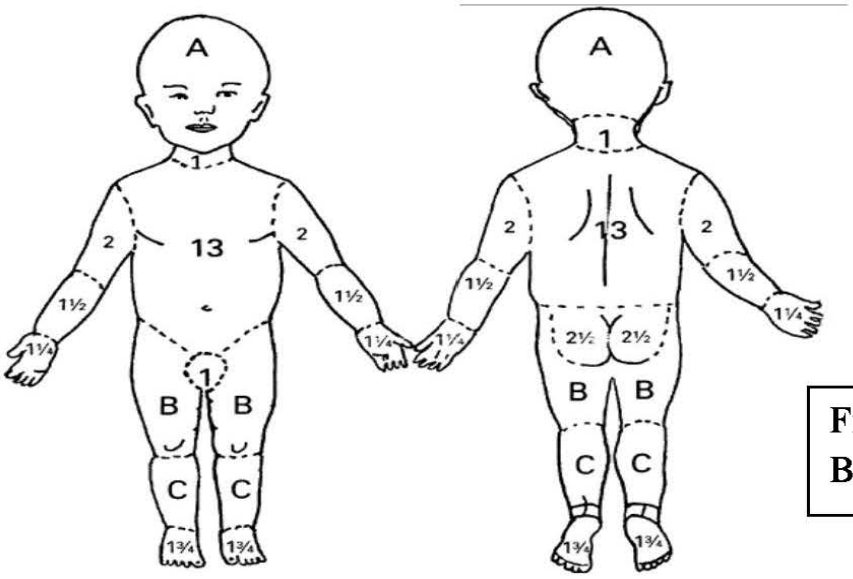


Fig 7: Lund and Browder chart

Area	Age 0	Age 1	Age 5	Age 10	Age 15
A = ½ of Head	9½	8½	6½	5½	4½
B = ½ of Thigh	2¾	3¼	4	4¼	4½
C = ½ of Leg	2½	2½	2¾	3	3¼

Table 3: Lund and Browder chart for estimation of % of TBSA

Area	0-1 Yr	1-4 Yr	5-9 Yr	10-14 Yr	15 Yr	Adults
Head	19	17	13	11	9	7
Neck	2	2	2	2	2	2
Ant.Trunk	13	13	13	13	13	13
Post.Trunk	13	13	13	13	13	13
Rt.Buttock	2.5	2.5	2.5	2.5	2.5	2.5
Left Buttock	2.5	2.5	2.5	2.5	2.5	2.5
Genitalia	1	1	1	1	1	1
Rt.Upper arm	4	4	4	4	4	4
Lt.Upper arm	4	4	4	4	4	4
Lt.Lower arm	3	3	3	3	3	3
Rt. Lower arm	3	3	3	3	3	3
Lt. Hand	2.5	2.5	2.5	2.5	2.5	2.5
Rt. Hand	2.5	2.5	2.5	2.5	2.5	2.5
Rt. Thigh	5.5	6.5	8	8.5	9	9.5
Lt. Thigh	5.5	6.5	8	8.5	9	9.5
Rt. Leg	5	5	5.5	6	6.5	7
Lt. Leg	5	5	5.5	6	6.5	7
Rt. Foot	3.5	3.5	3.5	3.5	3.5	3.5
Lt. Foot	3.5	3.5	3.5	3.5	3.5	3.5

WOUND CARE:

While resuscitating a patient with burn injury, after assessing the airway, one should focus their attention to the burn wound. Treatment varies depending upon the characteristics and the size of the wound but all of them are done with a aim of painless and rapid healing.

Current therapy for the management of burn wounds comprises of three stages namely, assessment, management and rehabilitation. To start with the burn depth and burn size are assessed followed by which the management phase begins, which include thorough cleaning and debridement of the burn wound. Then appropriate covering materials are used to dress the wound, which serve numerous functions.

First, the dressing provides protection to the damaged epithelium, reduces the colonization of bacteria and fungi in the wound and it maintains the extremities in the desired position of function by the splinting action.

Second, the dressing acts as a barrier thereby reducing heat loss by evaporation and minimize cold stress.

Third, as the burn wounds are painful, the dressing serves comfort.

The type of dressing to be applied on the burn wound varies. Since there is only minimal loss of barrier function in case of first degree wounds, dressing is not required in such cases. Topical salves can be applied to minimize the pain and to keep the skin moist. Oral non-steroidal anti-inflammatory drugs can be given to control pain.

Second degree burns must be treated in either of the following ways. Daily dressing with topical antibiotics, gauze pads with cotton and elastic bandages, or the wounds can be covered with temporary biologic or synthetic dressings. The third degree and deep dermal burns must be treated with excision of the necrosed tissue and skin grafting. The role of dressing in such cases is to hold the proliferation of bacteria in check until surgery is performed.

BURN WOUND DRESSINGS:

The various types of dressings which can be used in case of burn injuries are given below,

1. Antimicrobial Salves : Silver sulfadiazine, mafenide acetate, bacitracin, neomycin, polymyxin B, nystatin, mupirocin.
2. Antimicrobial Soaks : 0.5% Silver nitrate, 5% Mafenide acetate, 0.025% Sodium hypochlorite, 0.25% Acetic acid.

3. Synthetic coverings : Opsite, biobrane, transcyte, integra

4. Biologic coverings : Xenograft, allograft

Synthetic and Biologic Dressings:

Nowadays antimicrobial dressings are replaced by synthetic and biologic dressings in current clinical practice. Such synthetic and biologic dressings besides providing an effective barrier to evaporate losses, serve as stable coverage for burn wounds and also decrease pain in them. These dressings do not impair epithelialisation unlike most topical antimicrobials.

Biologic coverings include allograft (cadaver skin) and xenograft (pig skin). The synthetic dressings include Biobrane, Transcyte and Integra. These dressings are applied over the wound before bacterial colonization occurs. Hence such dressings are applied within 72 hours of injury. Biologic and synthetic dressings are used either for covering second degree wounds under which the epithelialisation occurs or to cover third degree burn wounds as a temporary cover before applying autograft. Each type of dressing has its own merits and demerits.

Biobrane:

Biobrane is a type of synthetic dressing material which is manufactured in the form of a sheet. It is made up of collagen-coated

silicone. On application, Biobrane gets adherent to the wound in about 24 to 48 hrs.This sheet makes the wound bed relatively painless, acts as an effective barrier to the loss of moisture from the wound and eliminates the need for repeated dressings. Once epithelialisation is completed, Biobrane sheet can be easily stripped off from the wound. When using this dressing over burn wound, one must be careful that massive exudate does not get collected beneath the Biobrane sheet, as it may aid as an optimum environment for the proliferation of bacteria and subsequent wound infection. Biobrane sheets are used as dressings for the donor sites and also for superficial second degree burns.

Trancyte:

Transcyte is a type of synthetic dressing which contains growth factors prepared from lysed fibroblasts grown in culture. Studies report that the use of transcyte has reduced the incidence of autografting and the length of hospital stay. It has the benefit of stimulated wound healing along with other advantages of Biobrane. Transcyte and Biobrane have similar applications, with Transcyte can also be used to cover deep second degree wounds which heal with stimulation[22].

Integra:

Integra is a product that is made up of a combination of collagen matrix and silicone sheet. Collagen matrix serves as dermal substitute which on application engrafts into the wound. The silicone sheet serves as epidermal substitute and it is removed after two weeks and replaced with autograft.

Integra can be used to close full thickness burns and also serve as a dermal equivalent thereby inhibiting future scarring. The demerits of Integra are absence of antimicrobial properties and it may be complicated by wound infections. In addition to that, it requires two operations for covering the wound, as the silicone layer must be removed and replaced two to three weeks after application. One of the remarkable advantages of Integra is limitation of scarring. It is due to the presence of collagen matrix which serves as the dermal substitute[23].

Biological dressings include xenograft and allograft. The former is obtained from the pig skin while the latter is obtained from cadaver donors. These are applied over the burn wounds to serve the functions of the normal skin. The disadvantage with these types of dressings includes with passage

of time, they will be rejected by usual immune mechanisms and they may slough out.

Since patients with extensive burns are usually immunocompromised, these biological dressings will not be rejected for the first several weeks. Hence these dressings are used as a temporary means of dressing in cases of massive partial thickness burns. The demerits with allograft include increased risk of transmission of viral diseases.

Silver Sulfadiazine :

Silver sulphadiazine is a topical antibacterial which is being used for a long time as a topical burn cream on second and third degree burns. It curtails the proliferation of bacteria on the damaged skin. Studies conducted have shown that it promotes the healing process.

Silver sulfadiazine is a sulpha derivative and it is available as 1% solution suspended in a water soluble base. This chemical has very less penetration through the skin as it is poorly soluble. The mechanism of action of silver sulphadiazine on burn wounds was extensively studied. On application, silver is bound by bacteria. Sulfadiazine exhibits synergistic action when combined with subinhibitory levels of silver sulfadiazine. The slow and study actions of silver sulfadiazine with serum and other body

fluids which contain sodium chloride are responsible for its efficacy. In this way, the silver ions are delivered into the wound environment.

COLLAGEN – AN OVERVIEW:

Structure Of Collagen:

About 15% of the human body is made up of proteins which are natural polymers. Collagen comprises the major protein of the extracellular matrix. In mammals, collagen is the most abundant protein as it constitutes about 25% of the total protein. About 70% to 80% of the skin (dry weight) is comprised of collagen.

Fig 8: Collagen

The unique feature of collagen is the triple stranded helical structure. Collagen serves as a structural scaffold in various tissues. The main types of collagen found in connective tissue include Types I, II and III. Among the collagen found in the human body, 90% is comprised of these types.

FUNCTION OF COLLAGEN IN WOUND HEALING

Collagen not only functions as a structural support but along with the collagen derived fragments control many important cellular mechanisms such as synthesis of numerous proteins, cell shape and differentiation and migration.

The most abundant structural constituent of the dermal matrix is the Type I collagen. Through the formation of gelatin, collagenase helps in the dissociation of keratinocytes from the collagen rich matrix. Extracellular matrix regulates the cellular functions. Various specialized cell surface receptors process and transduce the information into the cells which is provided by the extracellular matrix macromolecules[24].

The major functions of these receptors include initiation of migration of epithelial cells, deposition of collagen, contraction of wounds and induction of matrix degrading collagenase.

A polypeptide with the repeating sequence (Gly – X – Y) forms the basic unit of collagen. Gly, X and Y represent Glycine, proline and hydroxyproline.

The molecule thus formed twists into a left-handed helix. A triple helix is formed, when these left handed helices wrap around each other. The molecule may be made up of either 2 or 3 different alpha chains, or 3 identical alpha chains, depending on the type of collagen. There may be a continuous stretch of triple helix or it may be interrupted by non-collagenous segments.

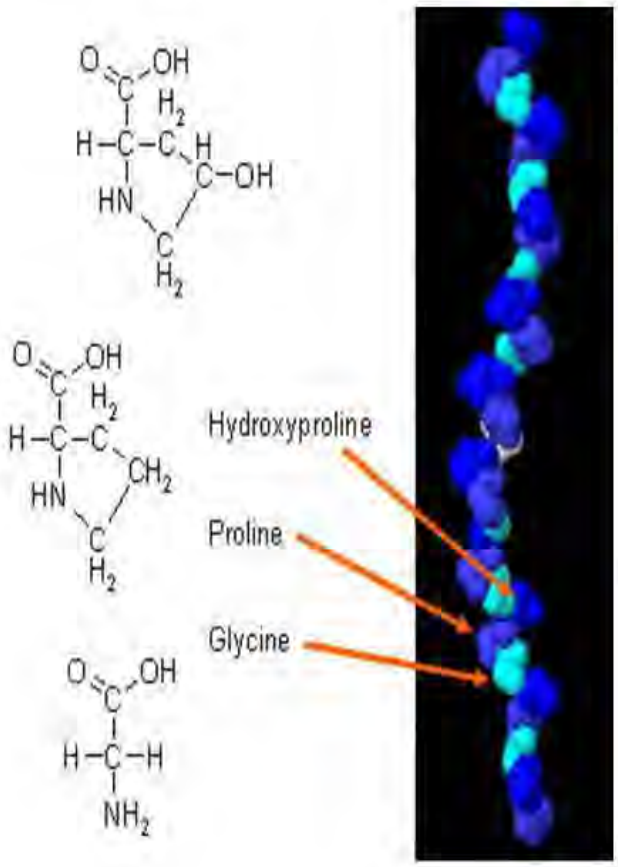


Fig 9 : Composition of Collagen

Every third position in the repeating amino acid sequence is occupied by glycine, within the triple helical domain. As larger amino acids will not fit into the structure of the triple helix, Glycine is very essential for the triple helical conformation.

X and Y positions are usually occupied by proline. Y position may be occupied by hydroxyproline, which are unique amino acids present in the collagen. Numerous lysine derived inter and intramolecular cross-links are present which stabilizes the collagen molecule.

Types Of Collagen:

Collagen constitutes a group of proteins and about 19 different types of collagen have been studied. These collagen types have been classified into three groups, based on the ability of the collagens to form fibrils.

The first group of collagens is called fibril forming collagens. They form banded fibrils and they are the most easily recognized forms of collagens. The collagens belong to this group include Type I, II, III, V and XI collagens.

In the proteins present in the second group of collagens, non-collagenous sequences interrupt the collagenous domains. The collagens belong to this group include Types IX, XII, XIV and XIV collagens. These

collagen types are unique because they contain glycosaminoglycans covalently linked to the protein.

The third group called non-fibrillar collagens, which include Types IV, VI, VII and X. They also include network forming collagens, anchoring fibrils and invertebrate cuticle collagens. With short triple helical collagen domains, these collagens constitute to form sheets of proteins.

Tissue Distribution Of Collagen:

A mixture of collagen types is present in all the tissues. Different collagen types are present in variable proportions and also differ in their structural organization[25].

Table 4: Types of Collagen

Type of collagen	Site
Type I	The most abundant collagen, which is present in scar tissue and tendons
Type II	Cartilage
Type III	Granulation tissue
Type IV	Basal lamina

Type V	Interstitial tissue
Type VI	Interstitial tissue
Type VII	Epithelia
Type VIII	Endothelial cells
Type IX	Cartilage
Type X	Hypertrophic and mineralizing cartilage
Type XI	Cartilage
Type XII	Interacts with types I and III

Collagen's Role In Wound Healing:

1. Hemostatsis

Platelet membrane has specific receptor sites on which binding of collagen occurs. This initiates the release of certain substances which cause adhesion and aggregation of platelets.

2. Wound debridement

Collagen has chemotactic effect on neutrophils and monocytes. Macrophages are formed from monocytes which act as scavengers and phagocytose foreign bodies.

3. Granulation and angiogenesis

Collagen releases substances which help in the growth of new capillaries. These new capillaries are responsible for the deposition of new fibers.

4. Fibroblastic activity

Collagen has a chemotactic effect on fibroblasts thereby stimulating their migration and proliferation. Collagen also promotes fibrillogenesis and governs the restoration of new tissue by organized fibers.

5. Re-epithelialisation

Keratinocytes migration, differentiation and their growth are influenced by collagen. Collagen arranges a provisional matrix for the migration of the keratinocytes by binding with fibronectin.

6. Wound remodeling

The formation of scar tissue is reduced by collagen by means of deposition of oriented and organized fibers. Collagen also determines the amount of collagenase produced by keratinocytes.

MATERIALS AND METHODS

Source of data:

This study includes in-patients and out-patients with partial thickness (1^{st} and 2^{nd} degree) burns of Government Royapettah Hospital.

Method of collection of data:

- All patients were interviewed as per the proforma and a complete clinical examination was done.
- Patients with partial thickness burns involving <40% of the total body surface area are assessed.
- Cases are allocated randomly into test group and control group.
- Cases in test group were treated with collagen dressing.
- Cases in control group were treated with silver sulphadiazine dressing.
- Groups are done taking into account, the confounding factors, which are matched.
- Cases are assessed for healing time, pain, healing quality, infection and patient compliance.

Study design:

A prospective comparative study

Sample size:

30 patients in each category

Inclusion criteria:

- All patients with partial thickness burns, involving <40% of the total body surface area
- Burn wounds not older than 24 hours

Exclusion criteria:

- Patients with full thickness burns
- Patients with burns involving >40% of the total body surface area
- Patients with electrical and other non-thermal burns
- Patients with burn wounds older than 24 hrs
- Patients with facial burns / perineal burns

***Materials Used*:**

❖ *For Collagen Dressing:*

Xenogenous collagen membrane branded KOLLAGEN, which is supplied by EUCARE pharmaceuticals private limited, Chennai was used for this study.

The collagen used for this study is a purified reconstituted collagen. The collagen which is free from other components that are normally associated with it in its native state is referred as purified collagen. Reconstitution is the process in which reassembling of the collagen into individual triple helical molecules with or without their telopeptide extensions is done. Then it is brought into solution after which it is regrouped into the desired form.

Cross-linking of this reconstituted collagen is then done with tanning agents like chromium sulphate or gluteraldehyde, thereby improving its tensile strength to make it insoluble. Besides lowering its antigenicity, the cross-linking decreases its rate of resorption.

The collagen membranes are available in various dimensions such as 5 x 5 cm, 10 x 10 cm and 25 x 25 cm. the thickness of these collagen membranes is 0.6 mm. Sterilization of these collagen membranes is done by

gamma irradiation and marketed in aluminium pouch packing, which contains a mixture of isopropyl alcohol and water. It has a shelf life of about 5 years at ambient temperature.

❖ *For Silver Sulphadiazine Dressing :*

Silver sulphadiazine is available as 1% solution suspended in a water soluble base. 1% silver sulphadiazine cream is used for the topical application over the burn wounds.

Technique Of Application:

❖ *Collagen Dressing:*

Under strict aseptic precautions, under general anesthesia, the burn wound must be first washed thoroughly with normal saline. Necrotic tissue and dead skin are removed from the burn wound.

Fig 10: Collagen application

In order to wash off the preservative agents, collagen should be thoroughly washed with normal saline and then collagen dressing is applied over the wound, trimming with the scissors so as to cover the entire area. Within one hour, the membrane dries and becomes adherent to the wound.

❖ *Silver Sulphadiazine Dressing:*

After washing the burn wound with normal saline, dead skin and necrotic tissue are removed from the burn wound. Then dressing is done after topical application of 1% of silver sulphadiazine.

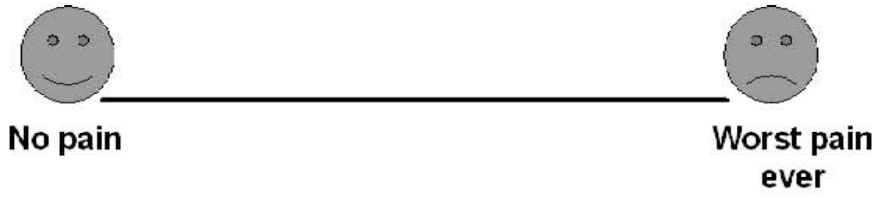
Patients of both groups are given intra venous broad spectrum antibiotics and intramuscular analgesics. The scars in both groups are managed with scar massaging and application of pressure garments.

Results analysis:

The results obtained are compared using the following criteria:

- Pain score is based on the own words of the patients as pain being subjective. It is on a visual analogue score of 0 to 10. Pain score is elicited after 24 hrs of application of the dressing. 0 refers to no

pain and 10 refer to maximum pain tolerable by the patient



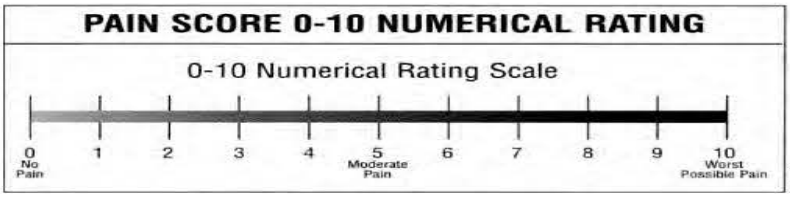


Fig11: Pain scale

- Infection in the burn wounds is assessed visually by presence or absence of any pus beneath the dressing. When there is presence of any infection, pus is sent for culture and sensitivity.
- Number of days required for complete epithelialisation of the wound is measured as the rate of healing
- Scar formed at the burn wound sites is compared between the two groups as marked as either good or bad, depending upon the degree of contracture.
- Compliance of the patient is elicited by the feedback given by the patient regarding the comfortability of the dressing during follow-up.

RESULTS

The following were the pictures taken on application of collagen dressing, two days and two weeks after the application of collagen in patients presenting with partial thickness burns.

Fig 12: On Admission to the Hospital

Fig 13: Before application of collagen

Fig 14: Immediately after application of collagen dressing

Fig15: one week after collagen application

Fig 16: Two weeks after collagen application

Pain score:

On a scale of 0 to 10, pain scoring was done after 24 hours of applying the dressing. Pain was considerably reduced in collagen group.

Table 5: Pain Score

Pain score	Collagen	SSD
Observations	30	30
Mean	2.87	7.10
Standand deviation	0.937	0.759
Standard error of mean	0.171	0.139

As per **Independent sample 't' test**, p value is <0.001.

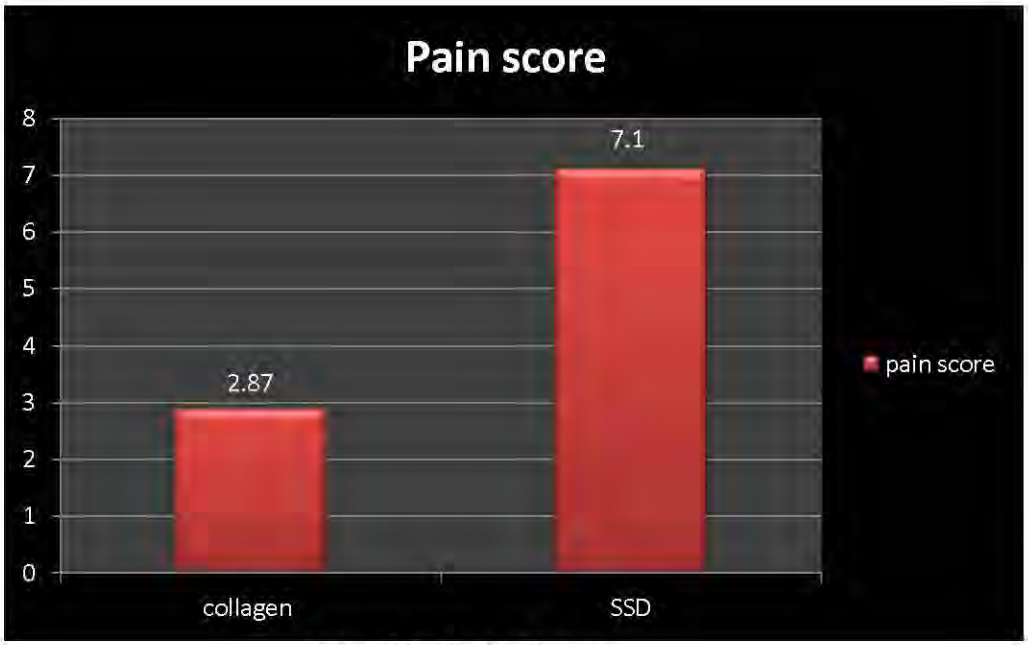


Fig 17 : Pain Score

Infection:

Number of patients who had infection (out of 60 patients). Infection was assessed by looking for any pus under the dressing. If infection was present, pus was sent for culture and sensitivity and appropriate antibiotics started.

Table 6: Infection - Cross-tabulation

			Infection		
			Absent	Present	Total
Group	Collagen	Count	26	4	30
		% within Group	86.7%	13.3%	100.0%
	SSD	Count	18	12	30
		% within Group	60.0%	40.0%	100.0%
Total		Count	44	16	60
		% within Group	73.3%	26.7%	100.0%

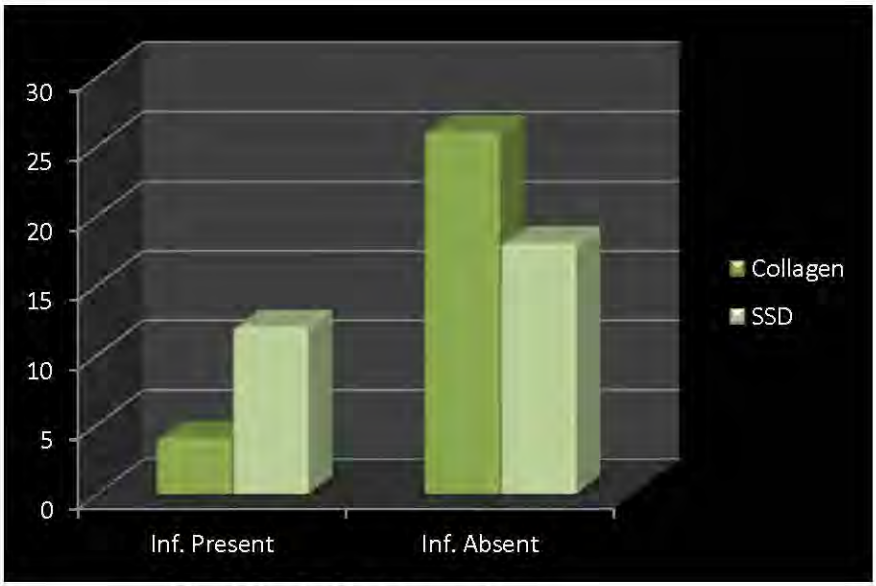


Fig 18 : Infection rate

As per **Chi-Square test**,

X^2 value	5.455
Degree of freedom	1
'p' value	0.020

Rate of healing:

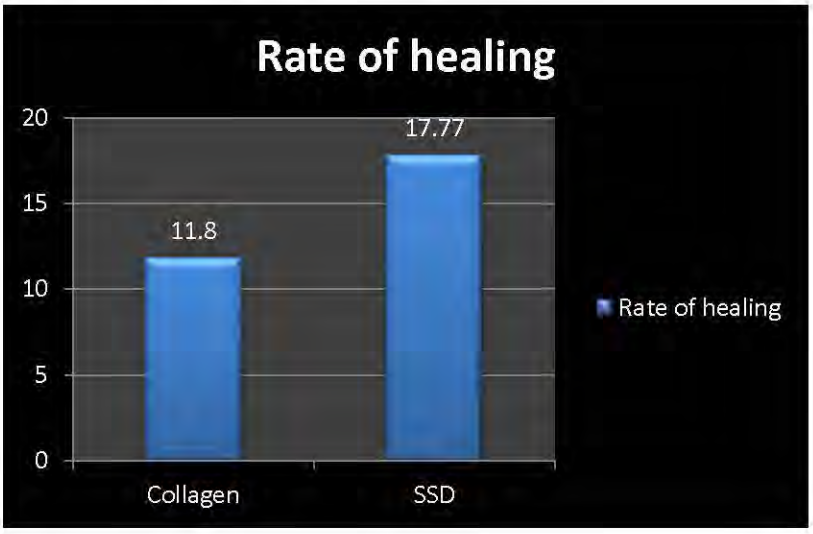


Fig 19 : Rate of Healing

Rate of healing is calculated as time taken for complete epithelialisation of wound counted in number of days.

Table 7: Rate of Healing

Rate of healing (no. of days)	**Collagen**	**SSD**
Observations	30	30
Mean	11.80	17.77
Standard deviation	0.925	1.357
Standard error of mean	0.169	0.248

As per **Independent sample 't' test**, p value is <0.0001.

Resultant scar:

Resultant scar is assessed at the end of 4 weeks and is noted as good or bad depending on the amount of contracture.

Table 8: Scar - Cross-tabulation

			Scar		
			Good	Bad	Total
Group	Collagen	Count	25	5	30
		% within Group	83.3%	16.7%	100.0%
	SSD	Count	11	19	30
		% within Group	36.7%	63.3%	100.0%
Total		Count	36	24	60
		% within Group	60.0%	40.0%	100.0%

As per **Chi-Square test,**

X^2	13.611
Degree of freedom	1
'p' value	<0.001

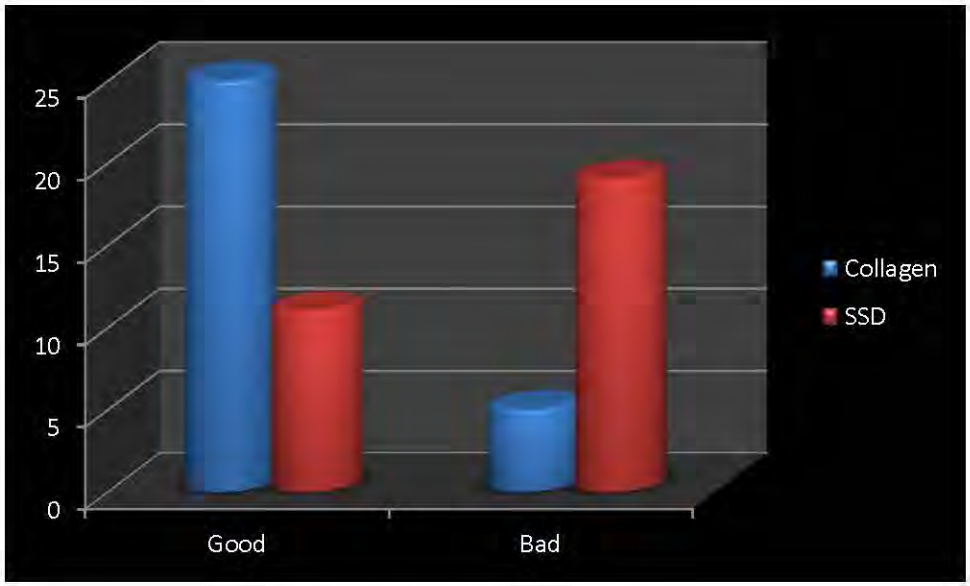


Fig 20 : Resultant Scar

Patient compliance:

Patient compliance is based on comfortability of the dressing as told by the patient during follow-up at 2 weeks and 4 weeks is noted as good or bad.

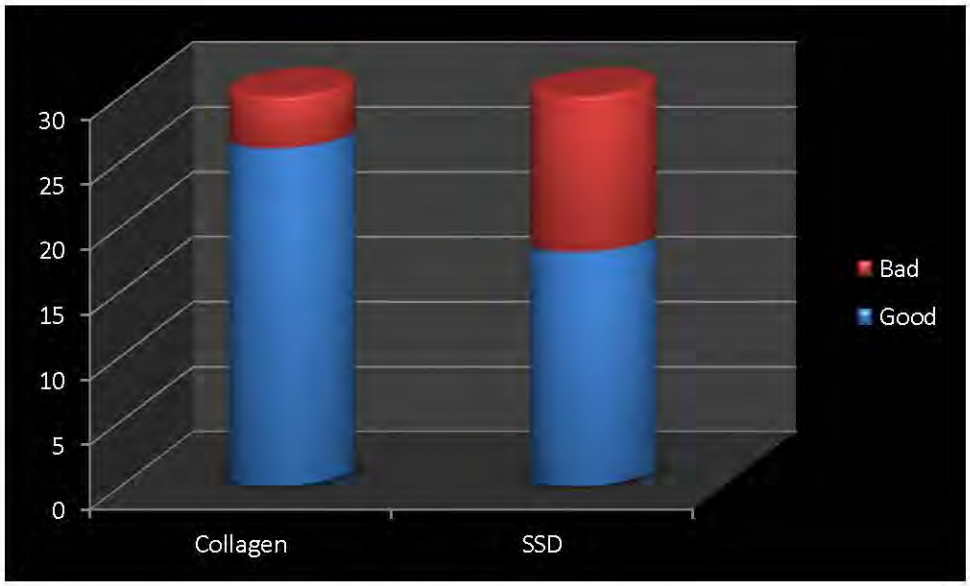


Fig 21 : Patient Compliance

Table 9:Compliance - Cross-tabulation

			Compliance		
			GOOD	BAD	Total
Group	Collagen	Count	26	4	30
		% within Group	86.7%	13.3%	100.0%
	SSD	Count	18	12	30
		% within Group	60.0%	40.0%	100.0%
Total		Count	44	16	60
		% within Group	73.3%	26.7%	100.0%

As per **Chi-Square test**,

X^2	5.455
Degree of freedom	1
'p' value	0.020

DISCUSSION

The denuded areas of the skin pose a real challenge to surgeons, who treat traumatic wounds, abrasions and burns. Raw areas of skin cannot prevent the loss of body heat as the normal skin does by controlling vasodilatation and sweat formation.

These areas continuously loose surface fluid and electrolytes, since the barrier of intact skin and keratin is not present to prevent the same.

The keratin layer of skin is a very effective anti-microbial barrier. Denuded areas are devoid of this protection thereby delaying wound healing by exposing vulnerable areas of subcutaneous tissues to infection.

The orderly ingrowth of epithelium needs a layer of collagen to act as the scaffold on which it grows and arranges itself. Denuded areas are unable to provide this effectively, leading to formation of extensive scars and even keloids.

The intact epithelium provides a protective layer over cutaneous nerves otherwise these areas expose the nerves and cause pain and tenderness.

It is for these purposes that denuded areas need a temporary cover till such times that the body is able to manufacture a cover of its own or till such times the surgeon is able to cover it by a skin graft.

Wounds that are left uncovered are prone to infection and scarring with additional clinical problems. It has been well documentated that the incidence of infection and degree of contraction are considerably reduced when wounds are dressed with biologic materials rather than left exposed or dressed with non-biologic material during healing. The fact that grafted wound heals faster with less complication than an open wound has been realized for almost a century.

Silver sulphadiazine dressing for burns has been used as one of the standard dressing in many centers. In the present study, collagen was used as an alternative to silver sulphadiazine dressing to cover the raw areas during the initial phase of healing in 30 out of the 60 patients included in the study.

It was observed that xenogenous collagen membrane had good conformability in lining mucosa and skin i.e. it was supple and adapted to the wound no matter what the contour was.

Pain Score:

Burn wounds are painful conditions due to the exposed nerve endings and as a result of this reduction of pain, patient morbidity is significantly reduced.

Collagen when used over the raw area provides the coverage for sensitive nerve endings thereby diminishing degree of pain significantly.

The average pain score in the range of 0 to 10 was 7.10 in the silver sulphadiazine group and 2.87 in the collagen group. The p value is < 0.05, which is statistically significant reduction in pain. This result is in accordance with the study conducted by Rajendra Desai[26]

Infection:

Infection of the wound is one of the most common complications because of the presence of necrotic tissue and tissue ischemia in burns and presence of dirt in abrasions as most of them are traumatic. Infection in turn leads to delayed healing of the wound. Reduction in the infection rate improves the quality of life.

In my study, infection was present in 40% of the patients in silver sulphadiazine group whereas it was only 13.3% in the collagen group. The p value is <0.05 which indicates lower rate of infection with collagen dressing. None of the cases showed any adverse reaction to the collagen, proving its safety as a biological dressing. This result is in accordance with Gupta RL[27].

Rate Of Healing:

Rate of healing is measured by the number of days required for complete epithelialisation of the wound. By decreasing the number of days required for healing, patient can return back to normal activities faster.

In silver sulphadiazine group, healing was achieved on an average of 17.77 days, whereas in collagen group, it took 11.80 days. The p value is <0.05 . This shows that collagen dressing helps in decreasing healing time when compared to dressing with silver sulphadiazine. This was consistent with the study of Gupta RL, which shows a healing time of range from 10 to 14 days[28].

Scar:

The appearance of wound was restored to normal texture in about a month. Scar was assessed by the amount of scar contracture at the end of 4 weeks.

In my study, 36.7% of patients in silver sulphadiazine group had good scars, whereas 83.7% of patients in collagen group had good scars. The p value is <0.05. Hence collagen helps in tissue remodeling and gives a better scar when compared to dressing with silver sulphadiazine. This is in concurrence with the study done by Demling R H[29].

Patient Compliance:

Patients were asked to give feedback during follow-up regarding the comfortability of the dressing and the resultant scar after healing of the wound. Collagen dressing was considered comfortable as it was only one time application unless there was infection unlike conventional dressing in

which the patient had to be subjected to dressings at regular intervals subjecting them to painful stimuli over the raw nerve endings. The resultant scar was good in a significant amount of patients in collagen group when compared to the silver sulphadiazine group, hence there was better patient satisfaction.

Patient compliance in the silver sulphadiazine group was good in 60% whereas in collagen group it was 86.7%. The p value is <0.05. Hence there was better compliance rate observed with collagen dressing. This result was in accordance with the study conducted by Gerding RL[30].

CONCLUSION

Collagen serves as the second skin to the burn wounds and it is the ideal dressing to be used in patients with partial thickness burns.

Following the application of the collagen dressing over the burn wounds, pain was drastically reduced.

The infection rate in the burn wounds was effectively controlled by collagen dressing as it forms a temporary barrier between the environment and the wound.

When compared with wounds dealt with silver sulphadiazine, majority of patients in the collagen group had faster healing rate with complete epithelialisation of the burn wounds.

To conclude, collagen sheet decreases pain, reduces the need for analgesics, aids in early healing, limits the associated complications such as infection of the burn wounds as compared to the patients treated with silver sulphadiazine. As the resultant scar is better in majority of the patients using collagen, the morbidity of the patients is also reduced to some extent.

In view of the excellent tolerance and simple application of the collagen membrane, it can be recommended as an effective temporary biological dressing material in the management of partial thickness burns.

SUMMARY

In the present study, 60 patients were taken up for the comparison of collagen dressing and silver sulphadiazine dressing in partial thickness burns. The following observation was made:

- The collagen material was readily available and easily reconstituted for its simple and easy application
- The collagen membrane, on grafting, remained supple, moist and intact, until the wound heals
- It was remarkable in reducing the inflammatory phase of wound healing.
- It produced significant reduction of pain as it acted as a temporary covering material over the sensitive nerve endings of raw wounds.
- It reduced the rate of infection as it served the purpose of mechanical barrier preventing wound infection.
- The collagen membrane did not produce any allergic or antigenic reactions in my study
- It reduced the degree of scarring and tissue contracture as it was useful in inducing granulation and epithelialisation.

- It appeared to be sufficiently robust to withstand mechanical trauma
- Patient compliance was good with collagen dressing because of comfortability of the dressing, significant pain reduction and additional value of giving a cosmetically better scar.

By considering the above mentioned points, in this study, it was found that collagen membrane constitute an excellent alternative to other traditional methods of dressing, such as with silver sulphadiazine. In controlled clinical situations, when collagen membrane is used judiciously, it is both biologically acceptable and an excellent wound graft material.

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ANNEXURES

PROFORMA

Name :

Age :

Sex :

IP/OP number :

Mode of injury causing burns :

Time since burns :

Degree of burns :

Percentage of burns :

Allotted to collagen/conventional group :

Collagen group

Pain score after 24 hrs	:		
Evidence of infection	:	Present	Absent
Rate of healing in days	:		
Number of dressings done	:	Good	Bad
Total expenses	:		
Scar after healing	:	Good	Bad
Patient compliance	:	Good	Bad

Silver sulfadiazine group

Pain score after 24 hrs	:		
Evidence of infection	:	Present	Absent
Rate of healing in days	:		
Number of dressings done	:	Good	Bad
Total expenses	:		
Scar after healing	:	Good	Bad
Patient compliance	:	Good	Bad

Key to master chart :

S - silver sulphadiazine group

C - collagen group

NOD - number of dressings

Inf - infection

P - positive

N - negative

ROH - rate of healing in days

Compl- compliance

G - good

B - bad

Name	Age	Sex	IP/OP	Group	Pain score	Inf	NOD	ROH	Compl	Scar
Sulochana	55	F	8220	C	3	N	1	12	G	G
Murugammal	49	F	8900	C	2	N	1	11	G	G
Valarmathi	40	F	8059	C	2	N	1	11	G	B
Mumtaj	45	F	114537	C	2	N	1	13	G	G
Lalitha	30	F	22651	C	3	N	1	12	G	G
Devi	33	F	6773	C	2	N	1	11	G	B
Jothi	34	F	113335	C	2	N	1	13	G	G
Latha	30	F	111437	C	3	N	1	14	G	B
Sathya	27	F	19221	C	3	N	1	12	G	G
Thirumala	28	F	8073	C	3	P	1	14	B	B
Sangeetha	25	F	5858	C	2	N	1	12	G	G
Kamsala	21	F	112338	C	2	N	1	11	B	G
Sasikala	26	F	12232	C	2	N	1	12	G	G
Suganthi	13	F	14280	C	4	N	1	11	G	G
Jeyamala	13	F	8015	C	4	P	1	13	B	G
Abhi	8	F	21084	C	5	N	1	11	G	G
Shalini	7	F	1295	C	5	N	1	11	G	G
Venkatesan	65	M	20731	C	2	P	1	13	G	G
Damodaran	50	M	19525	C	2	N	1	12	G	G
Doss	30	M	9005	C	2	N	1	11	G	G
Suresh	30	M	8546	C	2	N	1	11	G	G
Mohanraj	36	M	3912	C	3	P	1	11	G	G
Ramu	32	M	114775	C	3	N	1	11	G	G
Baskar	30	M	1116111	C	2	N	1	11	G	B
Benmundal	26	M	21376	C	3	N	1	12	G	G
Rajasekar	22	M	111729	C	4	N	1	12	G	G
Narayanan	13	M	20061	C	3	N	1	11	G	G
Murugan	13	M	73413	C	3	N	1	12	G	G
Surendar	13	M	111438	C	4	N	1	12	B	G

Shanthi	29	F	8431	S	7	N	13	18	G	G
Eshwari	31	F	112243	S	7	P	13	18	B	B
Rudhra	7	F	113325	S	8	N	15	16	G	G
Kiruthika	9	F	7620	S	8	P	10	15	G	G
Vasantha	51	F	8591	S	7	N	14	19	G	B
Arulselvi	42	F	3614	S	6	P	13	18	G	B
Bhavani	45	F	1925	S	7	N	16	18	B	B
Elizabeth	28	F	20083	S	7	N	11	16	B	G
Priyadarshni	34	F	19112	S	7	P	15	20	G	B
Keerthana	33	F	8068	S	8	P	15	18	G	B
Manohari	29	F	22521	S	8	N	13	18	B	B
Uma	26	F	9106	S	8	N	16	19	G	G
Mary	22	F	3222	S	7	P	16	17	G	B
Abirami	23	F	1116183	S	7	N	14	19	B	B
Saranya	12	F	220	S	8	N	10	16	G	G
Ramya	11	F	3412	S	8	N	12	17	B	G
Arulraj	52	M	754	S	7	P	14	18	B	B
Jitendar	23	M	7900	S	6	N	10	16	G	G
Jaffer	44	M	21372	S	6	P	14	18	B	B
Karthikeyan	41	M	8300	S	6	N	13	17	G	B
Gowrishankar	39	M	630	S	8	P	16	20	G	B
Benjamin	36	M	112428	S	7	N	16	19	G	G
Ilamaran	25	M	111349	S	6	P	15	20	B	B
Manoj	31	M	1321	S	6	N	12	18	G	G
Vadivelan	29	M	111568	S	6	N	16	20	G	B
Perumal	22	M	542	S	7	P	14	17	B	B
Balamurugan	15	M	21266	S	8	N	13	18	B	B
Rajesh	11	M	20178	S	8	N	10	16	G	G

INSTITUTIONAL ETHICAL COMMITTEE
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Ref.No.5614/ME-1/Ethics/2013 Dt:04.07.2013
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Comparative Study of collagen dressing versus silver sulphadiazine dressing in partial thickness burns" – For Project Work submitted by Dr.K.Sathik Mohamed Masoodu, MS (GS), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE * Kilpauk, Chennai-10. * 09 OCT 2013

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